Appendix E

Greater Sage-Grouse Draft Monitoring Framework

APPENDIX E
GREATER SAGE-GROUSE DRAFT MONITORING FRAMEWORK

The purpose of this Draft BLM and Forest Service GRSG Monitoring Framework (hereafter, draft monitoring framework) is to evaluate the implementation and success of the BLM and USFS land use plans in maintaining and restoring habitat conditions necessary to support sustainable GRSG populations. Monitoring data will also be used to help inform adaptive management under these plans.

This draft framework outlines the general monitoring approach, consisting of implementation monitoring and effectiveness monitoring. Implementation monitoring will evaluate whether (and to what extent) the BLM and Forest Service LUP decisions to ameliorate threats to GRSG have been implemented. Effectiveness monitoring will consist of a multi-scale analysis of our habitat and disturbance monitoring data. Best available population data, provided by the states, will be used to supplement effectiveness analysis.

This draft monitoring framework establishes the use of measurable quantitative indicators for habitat availability and maintenance of habitat types (e.g., priority and general habitats) to ensure each agency's ability to make broad (yet consistent) generalizations about habitat across the range of the species. Monitoring methods and indicators are derived from the best available science. Corporate data-sets will be established or acquired so that data can easily be "rolled up" for reporting monitoring results across the range of GRSG, as defined by Schroeder et al. (2004); by populations and subpopulations as defined by Connelly et al. (2004); by LUP area; by the six WAFWA Sage-grouse Management Zones (Stiver et al. 2006) covered by the planning efforts; by BLM and USFS Priority and General Habitat; and by Priority Areas for Conservation (PACs) as defined in the GRSG Conservation Objectives Team (COT) Report (US Fish and Wildlife Service 2013). Funding support and dedicated personnel

for broad and mid scale monitoring will be renewed annually through the normal budget process.

Sage-grouse are a landscape species, and conservation is a scale-dependent process whereby priority landscapes are identified across the species range and appropriate conservation actions are implemented within seasonal habitats to benefit populations. Following guidelines established by multiple agencies in the Sage-grouse Habitat Assessment Framework (HAF; Stiver et al. 2010), this approach uses the four orders of GRSG habitat selection (Johnson 1980): first order (broad scale), second order (mid scale), third order (fine scale), and fourth order (site scale). Because LUP decisions are made largely at the broad and mid scale, this draft monitoring framework focuses on these two larger spatial scales. The need for fine and site scale habitat monitoring may vary by area depending on existing conditions, habitat variability, threats, and land health; however indicators at these scales will be consistent with the HAF. Thus, this draft monitoring framework includes methods, data standards, and intervals of monitoring at the broad and mid scales, while outlining indicators to be measured at all scales.

I. BROAD AND MID-SCALES

First order habitat selection at the broad scale describes the selection of physical or geographical range of a species. There is one first order habitat, the range of the species defined by populations of GRSG associated with sagebrush landscapes (Schroeder et al. 2004; Connelly et al. 2004). Additionally, there is an intermediate scale between the broad and mid scales that was delineated from floristic provinces within which similar environmental factors influence vegetation communities. This scale was developed by WAFWA and is referred to as the WAFWA GRSG Management Zones.

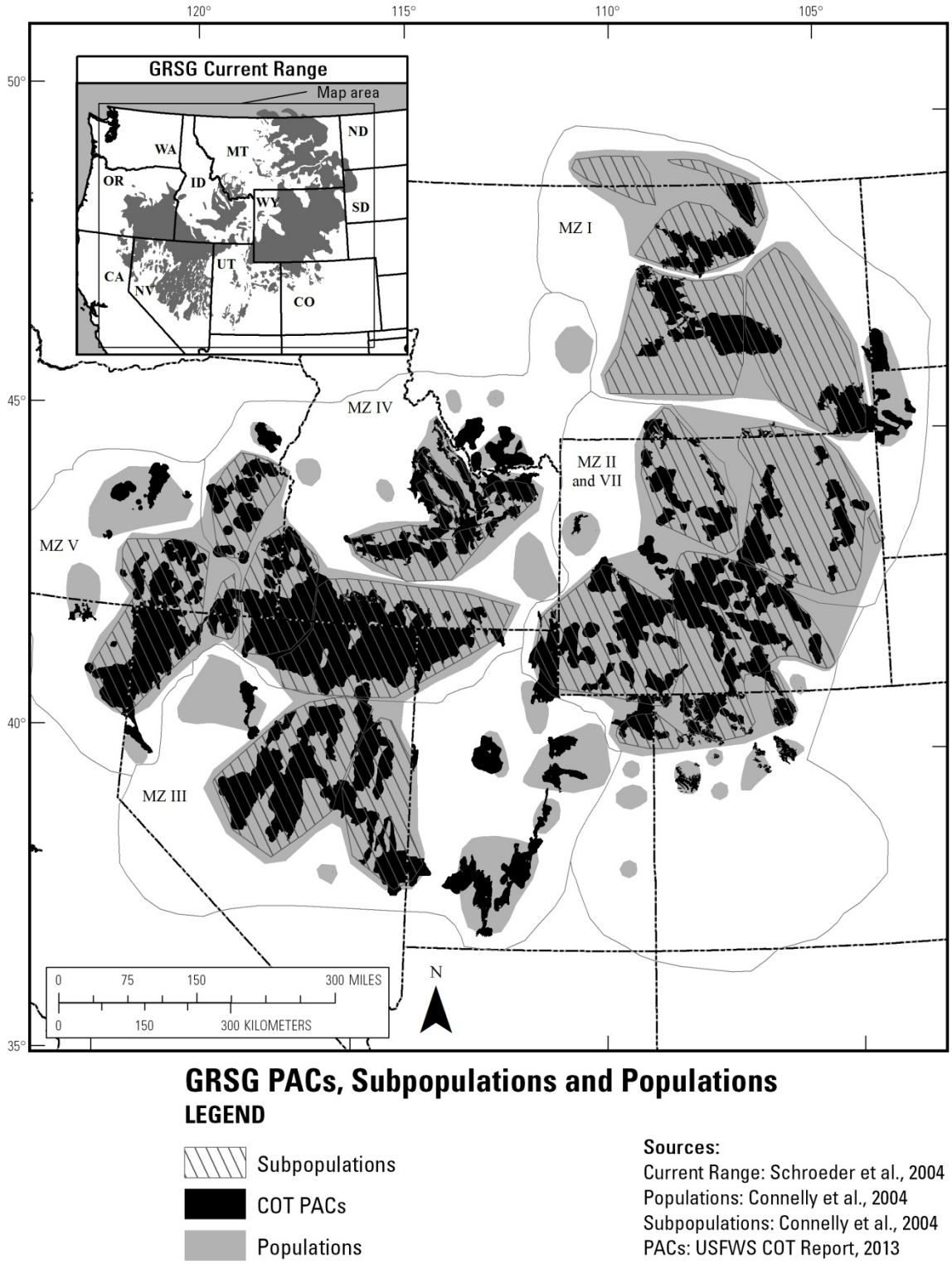
Second order habitat selection at the mid scale includes GRSG populations, subpopulations, and PACs. The second order includes at least 40 discrete populations and subpopulations (Connelly et al. 2004). Subpopulations range in area from 300 to 22,400 mi^2, while populations range in area from 150 to 54,600 mi^2. PACs range from 20 to 20,400 mi^2.

Broad and mid scale monitoring results will be reported at the appropriate and applicable geographic scale (**Table E-1**; **Figure E-1**).

Table E-1
Indicators for Monitoring Implementation of Decisions, Sage-Grouse Habitat, and Sage-Grouse Populations at the Broad and Mid Scales

Geographic Scales	Implementation	Habitat		Population (States)
	Decisions	Disturbance	Vegetation	Demographics
Broad Scale: From the range of GRSG to WAFWA Management Zones	LUP objectives, thresholds and management actions	Distribution of sagebrush within occupied habitat		WAFWA Management Zone population level and population trends
Mid Scale: From WAFWA Management Zone scale, subpopulation, and PAC scale	LUP decisions, vegetation/ mid scale decisions	Percent of sagebrush per unit area, anthropogenic footprint, density of energy development	Sagebrush patch characteristics, GRSG habitat indicators	Subpopulation scale, dispersal and lek complex trends

Figure E-1
Map of Greater Sage-Grouse Range, Populations, Subpopulations and Priority Areas for Conservation (PACs).



A. Implementation (Decision) Monitoring

The regulations for the BLM (43 CFR 1610.4-9) and USFS (36 CFR 219.12) require that land use plans establish intervals and standards for monitoring and evaluations, based on the sensitivity of the resource decisions involved. Implementation monitoring is the process of tracking and documenting the implementation (or the progress toward implementation) of land use plan decisions. A Nevada and Northeastern California Greater Sage-Grouse LUPA/EIS Implementation Workbook will be completed within one year of the Record of Decision to track the number and type of applicable implementation actions related to each decision for each resource program, and maintained as actions occur. The BLM and USFS will be documenting progress annually toward full implementation of the land use plan.

B. Habitat (Vegetation) Monitoring

The current geographic extent of sagebrush vegetation within the rangewide distribution of GRSG populations will be ascertained using the most recent version of the Existing Vegetation Type (EVT) layer in LANDFIRE (2006). LANDFIRE EVT was selected to serve as the base sagebrush layer for five reasons: 1) it is the only nationally consistent vegetation layer that has been updated since 2001; 2) the ecological systems classification includes multiple sagebrush type classes that, when aggregated, provide more accurate (compared to individual classes) and seamless sagebrush base layer across jurisdictional boundaries; 3) LANDFIRE performed a vigorous spatial accuracy assessment from which to derive the rangewide uncertainty of the base map 4) LANDFIRE EVT can be compared against the geographic extent of land that has the capability to support sagebrush vegetation using LANDFIRE Biophysical Setting (BpS) to provide a reference point for understanding how much sagebrush can be supported in a defined geographic area, and 5) LANDFIRE is consistently used in several recent analyses of sagebrush habitats (Knick et al, 2011, Leu and Hanser 2011, and Knick and Hanser 2011). Therefore, BLM has determined that LANDFIRE provides the best available data at broad and mid scales to serve as an initial base layer for monitoring habitat characteristics and by which disturbance changes are measured, incorporated, and reported. Along with the aggregated sagebrush base map, BLM will aggregate the accuracy assessment reports from LANDFIRE to document the cumulative accuracy for our final base map. Looking at the long term, BLM through its AIM program and specifically the Landscape Monitoring Framework, will provide field data to the LANDFIRE program to support overall accuracy improvements in their products.

Within the US Forest Service specifically and BLM in isolated areas, forest-wide and field office-wide existing vegetation classification mapping and inventories are available that provide a much finer level of data than provided through LANDFIRE. Where available, these products are useful below the mid scale for establishing baseline conditions for monitoring. The fact that they are not available everywhere however limits their utility for monitoring at the broad and

mid scale where consistency of data products is necessary regardless of land ownership.

The BLM is improving the quality of vegetation map products for broad and mid scale analyses through the Grass/Shrub mapping effort in partnership with the Multi-Resolution Land Characteristics Consortium (MRLC). The Grass/Shrub mapping effort applies the Homer et al. (2009) methodology to spatially depict fractional percent cover estimates for four components range and west-wide. These four components are the percent cover of sagebrush vegetation, percent bare ground, percent herbaceous vegetation (grass and forbs combined), and percent shrubs. One of the benefits of the design of these fractional cover maps is that they facilitate monitoring "with-in" class variation. This "with-in" class variation can serve as one indicator of sagebrush quality that we cannot derive from vegetation type information from LANDFIRE.

The base sagebrush layer, whether derived from LANDFIRE or Grass/Shrub, will allow for estimation of mid scale indicators, e.g. patch size and number, patch connectivity, linkage areas, and landscape matrix and edge effects (Stiver et al. 2010). The actual methods used to calculate these metric will be derived from existing literature (Knick et al, 2011, Leu and Hanser 2011, and Knick and Hanser 2011). Disturbance updates, generated annually, will be included into the base layer and the landscape metrics will be recalculated to examine changes in pattern and abundance of sagebrush at the various geographic boundaries. The appropriate geographic boundaries for this base layer include the range, management zone, population, subpopulation, and PAC. Other data sources would need to be used to report landscape metrics any finer than the PAC.

The sagebrush base layer and disturbance data provide the ability to calculate landscape metrics as one element of habitat monitoring at the broad and mid scales. Habitat quality, however, will be monitored using field data collected with a statistically valid sampling design (e.g., Landscape Monitoring Framework, a collaborative effort with NRCS on BLM lands (USDI-BLM 2011); AIM monitoring data (Toevs et al. 2011); and see "II. Fine and Site Scales"). These efforts can quantify indices such as percent annual grasses, species composition, sagebrush height, and bare ground at the PAC scale with known error estimates that are continually reduced as more data are collected. Point data will also be used to enhance the accuracy and precision of the Shrub/Grass mapping product. This product can in turn provide additional information about habitat quality at the mid scale. Long-term, BLM will be able to provide a suite of monitoring metrics for the PACs and larger scales that will provide a comprehensive view of sagebrush and GRSG habitat condition when combined with population data supplied by the states.

C. Habitat (Disturbance) Monitoring

Most of the decisions in this land use plan are in response to "Factor A: The Present or Threatened Destruction, Modification, or Curtailment of Habitat or

Range" in the U.S. Fish and Wildlife Service's (USFWS's) 2010 listing decision for GRSG (75 FR 13910 2010). The USFWS identified several "threats" affecting Factor A, therefore the BLM and USFS will monitor the relative extent of these threats on sagebrush, both spatially and temporally, to report on conditions at the appropriate and applicable geographic scales and boundaries.

Disturbance data will include:

1. Agriculture
2. Urbanization
3. Habitat treatments
4. Wildfire
5. Invasive plants
6. Conifer encroachment
7. Energy (oil and gas wells and development facilities)
8. Energy (coal mines)
9. Energy (wind towers)
10. Energy (solar fields)
11. Energy (geothermal)
12. Mining (active developments; locatable, leasable, saleable)
13. Infrastructure (roads)
14. Infrastructure (railroads)
15. Infrastructure (power lines)
16. Infrastructure (communication towers)
17. Infrastructure (other vertical structures)
18. Other developed rights-of-ways

Cumulative disturbance monitoring will aggregate these 18 threats into the following three general measures (see Attachment A):

1. Percent of sagebrush per unit area
2. Percent of non-habitat (human footprint) per unit area
3. Number of energy facilities and mining locations per unit area (density)

To accomplish disturbance monitoring, the BLM and the USFS will begin with a base layer of sagebrush described previously in Section B. Restored areas will

also be considered when evaluating the percentage of sagebrush on the landscape.

Next, the BLM and USFS will use the best available rangewide data (external and/or internal data) to evaluate anthropogenic and natural disturbances (direct physical footprint) of GRSG habitat based on threats listed in Factor A. The GRSG BER report (Manier et al. 2013) essentially provided a baseline collection of datasets across jurisdictions where available, however for some threats, the data were for federal lands only. Most of the data used in the BER were from external data sources, therefore the BLM will use the most currently available versions to evaluate changes (additional footprints) from the baseline dataset. A subset of these data (e.g. fire perimeters, mine and energy sites), provided by BLM field and state offices and USFS forests and regional offices, will be updated and reported to agency headquarters annually. The BLM will report the change in footprints for each of the 18 threats as well as cumulatively for the three general measures described previously.

D. Population (Demographics) Monitoring

State wildlife management agencies are responsible for monitoring GRSG populations within their respective states. The BLM and USFS have initiated a process to establish that WAFWA will coordinate collection of annual population data by state agencies. To establish certainty that the data will be provided to the BLM and the USFS, the existing memorandum of understanding signed by WAFWA, the BLM, the USFS, the Natural Resources Conservation Service, and the USFWS (http://www.blm.gov/pgdata/etc/medialib/blm/wo/Planning_and_Renewable_Resources/fish_wildlife_and/sage-grouse.Par.6386.File.dat/MOUonGreaterSage-Grouse.pdf) could be revised to outline collaboration, process, and responsibilities for data analysis and transfer related to management of GRSG. These population data will be used for analysis at the applicable scale to supplement habitat effectiveness monitoring of management actions.

E. Effectiveness Monitoring

The BLM and the USFS will analyze the monitoring data to characterize the relationship among the disturbance, implementation actions, and habitat condition at the appropriate and applicable geographic scale or boundary to accomplish effectiveness monitoring for the Nevada and Northeastern California Greater Sage-Grouse LUPA/EIS. This will involve evaluating the change in habitat conditions from the baseline conditions in relation to the goals and objectives of the plan and other rangewide conservation strategies (US Department of the Interior 2004; Stiver et al. 2006; US Fish and Wildlife Service 2013). When available from WAFWA and/or state wildlife agencies, effectiveness monitoring can be supplemented with population trends (taking into consideration the lag effect response of populations to habitat changes [Garton et al. 2011]). The compilation of broad and mid scale data (and population trends as available) will be on a 5-year reporting schedule or as

needed to respond to emerging issues. In addition, effectiveness monitoring will be used to identify emerging issues and research needs and will be consistent with and inform the BLM and the USFS adaptive management strategy (see "Adaptive Management" section of the EIS [Section 2.5.3]).

II. FINE AND SITE SCALES

Third order habitat selection at the fine scale describes the physical and geographic area within home ranges. At this level, maps of seasonal habitats (breeding, summer, and winter) and the connectivity between these seasonal use areas can be examined to determine limiting factors for populations, subpopulations, and PACs.

Fourth order habitat selection at the site scale is based on physical conditions and the geographic area within seasonal ranges to meet life requisite needs (e.g., nesting and brood rearing). Specific habitat measures are used at this scale as microsite conditions within the seasonal range to determine distribution and use. These measures are typically sampled across a defined area to inform third order habitat selection.

Details and application of monitoring at these two scales will be determined during implementation of the Nevada and Northeastern California Greater Sage-Grouse LUPA/EIS. The need for fine- and site-scale specific habitat monitoring will vary by area depending on proposed projects, existing conditions, habitat variability, threats, and land health. For example, implementation monitoring will track decisions in priority habitat; habitat vegetation monitoring will be conducted to evaluate projects targeting GRSG habitat enhancement and/or restoration; habitat disturbance monitoring will be conducted where mid-scale monitoring indicates the need for fine-scaled anthropogenic disturbance footprints; and population monitoring (in cooperation with state wildlife agencies) will be analyzed below the subpopulation/PAC level where needed for more specific effectiveness monitoring (some LUP objectives, activity plans, development plans, leasing plans, etc.).

Habitat indicator data collected at the fine and site scales will be consistent with the HAF and information provided in the GRSG guidelines (Connelly et al. 2000) as well as the core indicators in the assessment, inventory and monitoring (AIM) strategy (Toevs et al. 2011), and applicable USFS monitoring techniques. However the *metrics* for quantifying the indicators can be adjusted for local conditions. If local adjustments to metrics are made, the adjustments will be appropriate to the floristic province/GRSG management zone where the data were collected and reflect local plant productivity and GRSG habitat data collected within the area. In short, adjustments will be science-based (i.e., predicated on data collected locally and published in a peer-review outlet) and ecologically defensible (i.e., generally supported by the broad base of knowledge on sagebrush and GRSG provided in the peer-review literature). When

evaluating the land health habitat standard in designated GRSG habitats, the BLM will analyze core indicators and other supplemental site scale GRSG habitat indicators (see HAF) as appropriate for the seasonal habitat. The activity level plans will describe a sampling scheme for collecting indicators with a non-biased sampling design for vegetation treatments or management actions implemented at the site scale. In addition, the consistent collection of these data will be used to inform the classification and interpretation of imagery and habitat quality at the mid scale as described above.

For examples of current applications of disturbance and reclamation monitoring at the fine scale, see the BLM Wyoming Density and Disturbance Calculation Tool (http://ddct.wygisc.org/) and the BLM White River Data Management System (WRDMS) in development with the USGS.

III. FINAL MONITORING PLAN

This draft monitoring framework was developed for draft environmental impact statements to describe the proposed monitoring activities for this plan. The BLM and USFS will consider public comments and collaborate with other agencies to finalize the Nevada and Northeastern California Greater Sage-Grouse LUPA/EIS Sage-grouse Monitoring Plan.

LITERATURE CITED

Connelly, J. W., S. T. Knick, M. A. Schroeder, and S. J. Stiver. 2004. Conservation assessment of greater sage-grouse and sagebrush habitats. Western Association of Fish and Wildlife Agencies, unpublished report, Cheyenne, Wyoming, USA. http://sagemap.wr.usgs.gov/docs/Greater_Sage-grouse_Conservation_Assessment_060404.pdf.

Endangered and threatened wildlife and plants; 12-month findings for petitions to list the greater sage-grouse (*Centrocercus urophasianus*) as threatened or endangered. Proposed Rule. 75 Fed. Reg. 13910 (March 23, 2010).

Garton, E. O., J. W. Connelly, J. S. Horne, C. A. Hagen, A. Moser, and M. Schroeder. 2011.Greater sage-grouse population dynamics and probability of persistence. Pp. 293 – 382 in S.T. Knick and J.W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian biology (vol. 38).University of California Press, Berkeley, CA.

Homer, C. G., Aldridge, C. L., Meyer, D. K., Coan, M. J., and Bowen, Z. H. 2009. Multiscale sagebrush rangeland habitat modeling in southwest Wyoming: U.S. Geological Survey Open-File Report 2008–1027, 14 p.

Johnson, D. H. 1980. The comparison of usage and availability measurements for evaluating resource preference. Ecology 61:65-71.

Knick, S. T., and J. W. Connelly (editors). 2011. Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology Series (vol. 38), University of California Press, Berkeley, CA.

LANDFIRE. 2006.National existing vegetation type layer. USDI Geological Survey. http://gisdata.usgs.net/website/lanfire/ (21 August 2009).

Manier, D. J., D. J. A Wood, Z. H. Bowen, R. M. Donovan, M. J. Holloran, L. M. Juliusson, K. S. Mayne, S. J. Oyler-McCance, F. R. Quamen, D. J. Saher, and A. J. Titolo 2013. Summary of science, activities, programs, and policies that influence the rangewide conservation of greater sage-grouse (*Centrocercus urophasianus*): US Geological Survey Open–File Report 2013–1098, 170 pp.

Schroeder, M. A., C. L. Aldridge, A. D. Apa, J. R. Bohne, C. E. Braun, S. D. Bunnell, J. W. Connelly, P. A. Deibert, S. C. Gardner, M. A. Hilliard, G. D. Kobriger, S. M. McAdam, C. W. McCarthy, J. J. McCarthy, D. L. Mitchell, E. V. Rickerson, and S. J. Stiver. 2004. Distribution of sage-grouse in North America. Condor 106: 363-376.

Stiver, S. J., A. D. Apa, J. R. Bohne, S. D. Bunnell, P. A. Deibert, S. C. Gardner, M. A. Hilliard, C. W. McCarthy, and M. A. Schroeder. 2006. Greater sage-grouse comprehensive conservation strategy. Western Association of Fish and Wildlife Agencies. Unpublished report. Cheyenne, WY, USA. http://www.wafwa.org/documents/pdf/GreaterSage-grouseConservationStrategy2006.pdf.

Stiver, S. J., E. T. Rinkes, and D. E. Naugle. 2010. Sage-grouse habitat assessment framework – a multi-scale habitat assessment tool. Bureau of Land Management Unpublished Report. US Department

of the Interior, BLM, Idaho State Office, Boise, ID. http://wgfd.wyo.gov/web2011/Departments/Wildlife/pdfs/SG_HABITATASESSMENT0000669.pdf.

Toevs, G. R., J. J. Taylor, C. S. Spurrier, W. C. MacKinnon, and M. R. Bobo. 2011. Assessment, inventory, and monitoring strategy: For integrated renewable resource management. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO.

US Department of the Interior. 2004. Bureau of Land Management national sage-grouse habitat conservation strategy. US Department of the Interior, Bureau of Land Management, Washington, DC.

United States Department of the Interior, Bureau of Land Management. 2011. BLM Memorandum of Understanding Washington Office 220-2011-02. BLM Washington Office, Washington DC.

US Fish and Wildlife Service. 2013. Greater sage-grouse (Centrocercus urophasianus) conservation objectives: final report. US Fish and Wildlife Service, Denver, CO.

ATTACHMENT A. Geospatial data layers used to determine three factors for greater sage-grouse habitat disturbance monitoring at the broad and mid scales.

Geospatial Data Layer	Percent of Sagebrush	Percent of Non-habitat (Human Footprint)	Number of Energy and Mining Facilities
Sagebrush	X		
Areas with biotic potential for sagebrush	X		
Agriculture	X		
Urbanization	X		
Habitat treatments	X		
Wildfire	X		
Invasive plants	X		
Conifer encroachment	X		
Energy (oil and gas wells and development facilities)		X	X
Energy (coal mines)		X	X
Energy (wind towers)		X	X
Energy (solar fields)		X	X
Energy (geothermal)		X	X
Mining (active locatable, leasable, and salable developments)		X	
Infrastructure (roads)		X	
Infrastructure (railroads)		X	
Infrastructure (power lines)		X	
Infrastructure (communication towers)		X	
Infrastructure (other vertical structures)		X	
Other developed rights-of-way		X	

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